

All posts shall have the inner bark shaved off, knots trimmed and be pointed for driving before treatment.

Knots that are sound, smoothly trimmed, and do not impair the strength of the posts will be permitted. Decay, short kinks, and reverse bends will not be permitted. One way sweep not to exceed 1-1/2 inches will be permitted.

Defects of any kind which give the posts an unsightly appearance will not be permitted.

All posts shall be preserved and treated according to Section 846.

## SECTION 862 GUARDRAIL AND POSTS

### 862.01 GENERAL.

All steel components of the various types of guardrail shall be galvanized.

No burning, cutting, or welding will be permitted after galvanizing unless the item is regalvanized according to Section 854.

### 862.02 WIRE ROPE AND FITTINGS FOR CABLE GUARDRAIL.

Wire rope and connecting hardware shall meet AASHTO M-30, Type I, Class A, 3/4-inch rope. Connecting hardware shall develop the full strength of a single cable (25,000 pounds). Cast steel components shall meet AASHTO M-103.

- A. **Spring Assembly.** The tension spring assembly shall have a spring constant of 450 psi  $\pm$  50 pounds per inch, and shall permit a travel of 6 inches  $\pm$  one inch.
- B. **Socket Baskets and Wedges.** Socket baskets shall be designed for use with the wedge detailed on the Plans.
- C. **Threading.** Threads of externally-threaded parts shall be UNC, ANSI B1.1, Class 2A Tolerance. Internally-threaded parts shall meet the dimensional requirements of ASTM A-563.
- D. **Bolts, Nuts, and Washers.** Bolts shall meet ASTM A-307 and nuts to ASTM A-563, Grade A, or better. Both nuts and bolts shall be galvanized according to AASHTO M-232. Nuts shall be hex or heavy hex type.

Hook bolts, as installed, shall develop an ultimate pull open strength of from 500 to 1,000 pounds applied in a direction normal to the longitudinal axis of the post.

Washers shall be made of steel and shall be galvanized according to AASHTO M-232. They shall meet the dimensional requirements of ANSI B27.2, Type A plain washer.

- E. **Washer Plates.** End and line post washer plates shall meet AASTHO M-183 and shall be galvanized according to AASHTO M-111.
- F. **Substitutes.** Alternate hardware design will be considered for approval provided the connection details are compatible with the details in the Contract and the operational characteristics are similar to those of the hardware specified.

### 862.03 GUARDRAIL UNITS AND FITTINGS FOR W-BEAM GUARDRAIL.

W-Beam guardrail units, backup plates, flared end sections, and buffer end sections shall meet AASHTO M-180, Class A, Type 2. The terminal connector shall meet AASHTO M-180, Class B, Type 2.

- A. **Button Headed Bolts and Hex Bolts.** The 5/8-inch button headed bolts and hex bolts shall meet ASTM A-307 and nuts to ASTM A-563, Grade A or better. They shall be galvanized according to AASHTO M-232.
- B. **Plates.** The rectangular plate washers shall meet AASHTO M-180. Break-away cable treatment (BCT), cable end plates, bearing plates (timber), and anchor plates shall meet AASHTO M-180 and shall be galvanized according to AASTHO M-111.
- C. **Washers.** Washers shall be made of steel and shall be galvanized according to AASHTO M-232. They shall meet the dimensional requirements of ANSI B27.2, Type A plain washers.
- D. **Break-Away Cable Terminal Assembly.** The swaged fitting shall be machined from hot-rolled carbon steel meeting ASTM A-576, Grade 1035, and shall be annealed suitable for cold swaging. The swaged fitting shall be galvanized according to AASHTO M-111 before swaging. A lock pin hole to accommodate a 1/4-inch plated, spring steel pin shall be drilled through the head of the swage fitting to retain the stud in the proper position. After galvanization the head may be tapped 0.023 inch over the ANSI Class 2B Tolerance.

The stud shall meet ASTM A-449 and shall be galvanized according to AASHTO M-232. The threads shall be ANSI Class 2A fit before galvanizing. Before galvanizing, a 3/8-inch slot for the locking pins shall be milled into the stud end.

The wire rope shall meet AASHTO M-30 and shall be 3/4-inch preformed, 6x19, wire strand core or independent wire rope core (IWRC), galvanized, right regular lay, manufactured of improved plow steel, with a minimum breaking strength of 42,800 pounds. A galvanized rod type assembly may be substituted with a minimum breaking strength as specified.

The swaged fitting, stud, and nut shall develop the breaking strength of the wire rope.

The one-inch nut shall meet AASHTO M-164 and washers shall be made of steel; both shall be galvanized according to AASHTO M-232. After galvanizing, the pitch diameter of the nut may be tapped 0.023 inch over the ANSI Class 2B Toler-

ance. Washers shall meet the dimensional requirements of ANSI B27.2, Type A plain washers.

- J. **W-Beam Guardrail End Treatments.** W-beam Guardrail End Treatments shall meet the requirements of the National Cooperative Highway Research Program (NCHRP) Report 350, Test Level 3. The W-Beam Guardrail End Treatments shall be one of the types shown in the Plans.

The impact head shall be capable of flattening, cutting, kinking or bending the guardrail away from the impacting vehicle. The impact head shall be attached to the first post by two 3/8 inch lag screws as specified by the supplier. The first post and second post shall be installed in a galvanized steel foundation tube. A break-away cable assembly shall be anchored to the guardrail as shown in the plans. The remaining posts shall be break away posts and standard line posts as shown in the plans. The guardrail elements shall be of the lengths shown on the plans and be 12 gage sections as specified in AASHTO M-180. The timber posts shall meet requirements for materials that passed the crash testing.

#### **862.04 TREATED WOOD GUARDRAIL POSTS.**

The timber used for treated wood posts for beam guardrail shall be made from timber with a stress grade of 1,200 psi or more. Testing shall be according to West Coast Lumber Inspection Bureau, Southern Pine Inspection Bureau, or another appropriate timber association. Rectangular timber posts and offset blocks shall be either rough sawn (unplaned) or S4S with nominal dimensions shown in the Contract. The size tolerance of rough sawn blocks in the directions of the bolt holes shall be not more than  $\pm 1/4$  inch, and shall meet the requirements of the treated timber guardrail posts. Round treated timber posts used with W-Beam shall be 8-3/4 inches in diameter  $\pm$  one inch. Round posts shall be notched to receive wooden offset blocks before treatment. The notched flat surface shall be 5 to 6 inches wide and 14 to 15 inches long, or shall extend to the full length of the post. The minimum depth of the remaining post material, after notching, shall be 6-3/4 inches. Round posts may have a domed top in lieu of a flat top.

Round treated timber posts used with 3-cable guardrail shall be 5-1/2 inches in diameter  $\pm$  one inch and are required to be made from timber with a stress grade of 1,200 psi or more.

- A. **Quality.** The quality of all posts shall be governed by the following requirements:

1. No decay will be permitted.
2. Knots will be permitted if they are sound and smoothly-trimmed, and if they plainly do not impair the post's strength.
3. Checks wider than 1/4 inch or deeper than 3 inches will not be permitted.
4. One way sweep shall not exceed 1-1/2 inches.
5. Winding twist will be permitted unless exaggerated and unsightly.
6. Short kinks will not be permitted.
7. Defects of any kind which give the post an unsightly appearance will be sufficient cause for rejection.

- B. **Peeling and Trimming.** Round timber posts shall have all the inner bark shaved off and knots closely trimmed before treatment.
- C. **Preservative Treatment.** The preservative shall meet Section 846. All posts on the Project shall have the same treatment. Timber offset blocks shall be treated.

#### **862.05 STEEL GUARDRAIL POST.**

Steel posts, adjustment blocks, blockouts, attachment angles, and base plates shall meet AASHTO 270 Grade 36 and shall be galvanized after fabrication according to AASHTO M-111. Welding shall meet the current AWS D1.1.

#### **862.06 BOX BEAM.**

Box beam post and rail shall be structural tubing. Post base plates and splice tongues and plates shall meet AASHTO 270 Grade 36 structural steel. Rail shall meet ASTM A-500 cold-formed, welded, and seamless carbon steel structural tubing in rounds and shapes, Grade 1B, modified as follows:

- A. **Rail Tests.** All rail shall be tested according to ASTM E-436 modified as follows:
  1. Tests shall be conducted after all galvanizing and associated operations have been completed on the rail. The testing shall be conducted at a temperature of 0°F. (-18°C.) on galvanized specimens 2 inches x 7 inches in size, supported to span 7 inches. Galvanizing shall not be removed from galvanized rail specimens.
  2. The percent shear area will be determined by tests on 9 specimens, 3 from each of the 3 sides not containing a weld. The shear areas of the 3 specimens from the side with the lowest average shear area will be disregarded and the final average based on the remaining 6 specimens. The material represented by these specimens will be rejected if the average percent shear area is less than 50%.
  3. No mill transverse weld will be permitted on the rail sections. Longitudinal welds shall be made by the resistance weld process, shall be sound, free from defects, and shall not be repaired. Rail elements to be used in curves having a radii of 175 feet or less shall be shop formed to the required curvature.
  4. Before galvanizing the rail material, the manufacturer shall identify the rail to facilitate acceptance of the material. Identification shall be by heat number or some number used to identify heat number and the manufacturers unique coding. This identification shall be readable after galvanizing and shall be placed on the rail at 4-foot intervals.
- B. **Splice Plates and Expansion Plates.** The splice plates and expansion plates shall meet AASHTO 270 Grade 36. Nuts shall meet ASTM A-563, Grade A or better, and the plates with nuts attached shall be galvanized according to AASHTO M-111.
- C. **Bolts, Nuts, and Washers.** Bolts shall meet ASTM A-307 and nuts to ASTM A-563, Grade A or better, and be galvanized according to AASHTO M-232. Bolts

and nuts shall be the hex and heavy types. Washers shall be made and shall be galvanized according to AASHTO M-232. Washers shall meet the dimensional requirements of ANSI B27.2, Type A Plain Washers.

- D. **Certification.** Each box beam and box beam median barrier for a project shall be accompanied by certified test results of actual tests for the heat of base metal used in fabricating all rails, posts, base plates, splice plates, expansion plates, blockouts, and attachment angles in the shipment. Certified test results of actual tests performed to determine compliance with the galvanizing requirements of this Specification, are also required on component parts of the shipment.
- E. **Galvanizing.** The posts, bases, splice plates, expansion plates, blockouts, and attachment angles shall be fabricated and ready for assembly before galvanizing. Slots and round holes may be subsequently drilled, punched, burned or cut after galvanizing, and regalvanized according to Section 854.

## SECTION 868 INSULATION BOARD (POLYSTYRENE)

### 868.01 REQUIREMENTS.

Insulation Board (polystyrene) shall meet AASHTO M-230.

## SECTION 880 PAVEMENT MARKINGS

### 880.01 PAVEMENT MARKING PAINT.

#### A. General.

1. **Quality.** All paint shall be formulated from first grade materials and shall be suitable in all respects for application at elevated spray temperatures with drop-on glass beads using conventional traffic striping equipment. The finished paint shall be smooth and homogeneous, free of coarse particles, skins or any other foreign materials that are detrimental to its use or appearance.
2. **Manufacturing and Packaging of Preapproved Paint.** When preapproval of pavement marking paint is specified, the paint shall be manufactured in lot sizes no smaller than 1,000 gallons. The paint shall be screened with a 40